

# Afrodite Project - Proposal of Biocompatible Nipples for Patients with Breast Cancer and Victims of Accidents

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**Keywords**— *Nipples, Breast Cancer, 4.0 Technology.*

**Abstract**— *Through the ages, breasts have played multiple roles, ranging from a source of nourishment to a source of pleasure and a symbol of femininity. The loss of these not only poses challenges of a physical nature but also prominent psychological disturbances, especially when associated with the context of breast cancer. In the current period, it is observed that an estimated contingent of 2.3 million individuals faced this arduous battle in the year 2020 (according to data from INCA - Instituto Nacional de Câncer), a struggle that left a myriad of physical scars and psychological traumas in its wake. Among the painful sequels, the deprivation of the areola stands out, whose reconstruction, unlike the breasts themselves, presents a notably more complex challenge. Regardless of the gender of the affected person and the circumstances that led to the deprivation of that essential part of their integrity, it is imperative that all those who experience such misfortune receive unconditional support. It was in this spirit of solidarity that a meticulously crafted silicone prosthesis was conceived, with the purpose of reproducing the lost areola(s) for those affected by this painful situation. This piece is remarkable in its total customization, adapting precisely to a wide range of models. Nevertheless, it is worth noting that its application does not require surgical procedures, thus enabling the restoration of self-confidence and the sparkle in the eyes of those who have already suffered too much. It is pertinent to emphasize that this innovative endeavor received valuable support from the facilities of the FABLAB "Espaço Maker" of Colégio Puríssimo, equipped with devices such as scanners and 3D printers. With the guidance provided by specialized literature in the areas of reverse engineering, human anatomy, psychoanalysis, art history, and humanity, a deep knowledge was obtained that constituted secure foundations for the practices adopted in this context.*

## I. INTRODUCTION

The breasts are crucial parts in the feeding of a newborn, as evidenced during lactation, where mothers

secrete milk to breastfeed their infants. In the past, they were not seen as anything more than part of the female body, a fact that can be observed in the sculpture of the

Venus of Willendorf, where there is a striking presence of bare breasts, which were seen as nothing more than fertility symbols. Over time, with the predominance of men in the religious and artistic realms, breasts began to be portrayed in paintings and statues as sexual objects, particularly dating back to Classicism (FAUSTINO, 2023).

However, biologically speaking, breasts are nothing more than a combination of tissues (adipose, connective, and glandular), blood vessels and lymphatics, and nerve fibers (VARELLA, 2023).



#### ANATOMY OF A FEMALE CHEST

(source: <https://www.infoescola.com/anatomia-humana/glandulas-mamarias/> acesso em 03/03/2023)

Nevertheless, breasts are important parts for women, as evidenced by the increase in searches for implantation and explantation (FACINA, 2023). Losing them is not easy, especially when it does not occur by choice, but due to accidents or cancer - in the latter case, breast reconstruction is provided by the SUS free of charge, but the nipple as a whole is not restored, according to data from the State Health Secretariat.

However, loss also affects men, but while women's loss is widely discussed and addressed, men's is rarely mentioned, which can cause discomfort when they wish to share their experiences.

In summary, everyone deserves support when facing the loss of their breasts, nipples, and/or areolas, after all, accidents or a cancer diagnosis can deeply impact psychological well-being, resulting in feelings of guilt, trauma, isolation, anxiety, and even depression. There are, of course, paid options available, such as tattooing, filling with hyaluronic acid, and even adhesive molds for the skin. However, none of them is completely effective, since tattooing does not restore nipple volume, something highly desired by men and women for situations such as going to the beach, wearing specific clothes. Hyaluronic acid filling can result in adverse reactions and is not a long-term

solution (BIERNATH, 2023), while prefabricated molds can be inaccurate, leading to areola asymmetry. In addition, the personalized molding procedure can be uncomfortable and invasive, as it usually involves applying plaster to replicate the breast's structure, which can be aversive for many people who wish to avoid physical contact. Both tattooing and filling involve the use of needles, which can be emotional triggers for some people, given their past experiences.

In summary, although there are alternatives to deal with the loss of the areolas, many people end up not seeking these options, due to the reasons mentioned above and also due to socioeconomic factors, such as lack of resources or concerns about cancer recurrence, among others.

Keeping these needs in mind, the project seeks to create personalized prostheses for the nipple and areola through a process of scanning and 3D printing, eliminating the need for direct contact and needles, which provides greater confidence and privacy, restoring the patient's self-esteem and self-love.

## II. OBJECTIVES AND PROJECT RELEVANCE

After a thorough analysis of cases, consultation with specialists, such as the Rio Claro Cancer Support Network, consideration of reports of traffic accidents in which victims had their nipples amputated, and review of various documents and works on the subject, the project for personalized areola prostheses for breast cancer patients or victims of accidents was developed. A common element to all these situations is the profound impact on the psychological state of the individuals affected.

It is worth noting that the cost of the product is quite affordable, and the necessary knowledge for its production was acquired through instructions regarding the use of scanner and 3D printer, 3D modeling, and silicone pigmentation. Furthermore, the materials used are of high quality and have remarkable durability, making the cost-benefit very attractive. Each areola costs R\$ 12.00, including all necessary inputs.

This work was driven by the Pink October movement, a period of mobilization and awareness about the fight against breast cancer. Its realization is guided by humanitarian and solidarity objectives, aiming to restore smiles to the faces of those who had lost hope. The project plays a crucial role in improving people's psychological state, helping to combat problems such as depression, anxiety, trauma, and distortions in self-image, all derived from experiences of great impact. This is particularly

relevant in everyday contexts, where both women and men may feel comfortable displaying their bodies and wearing specific clothes. It is important to emphasize that the satisfaction of the project focuses on the people who can benefit from it, and not just on those who observe it.

### III. PROJECT DEVELOPMENT

To conduct this study, the reverse engineering technique was employed to simulate the procedure that would be performed on humans. Initially, a breast model was selected from the Thingiverse database (a website with free 3D models for download). This model was then imported into the Tinkercad platform (a free electronic platform for 3D modeling), where the mold was duplicated and the areola was subsequently removed from one of the breasts, thus simulating a patient in the postoperative phase.



*Breast's 3D modelling. Source: writers (2023)*

The next step involved the use of Simplify3D software (slicing software), which refined the details in preparation for the breast printing process.

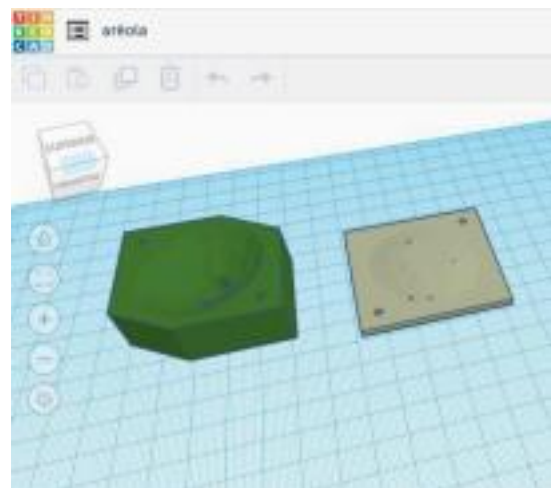


**Printed breasts. Source: writers (2023)**

After the completion of the prints, digital scanning of the breasts was performed, simulating a patient with reconstruction of only one breast. The data obtained by the 3D scanner were processed in the Tinkercad platform, and the mold was created to be printed.



*Breasts being scanned. Source: writers (2023)*



*3D modeling of the molds. Source: writers (2023)*

The digitally developed molds were printed on the same 3D printer, but now in high definition, generating structures faithful to the originals. These molds were then treated with Kala brand mold release spray and filled with Du Latex brand industrial silicone. The predominant choice was the addition model Platsil Gel 00 silicone, which, besides being biocompatible, exhibited an appropriate texture and provided the desired result in the pigmentation process.

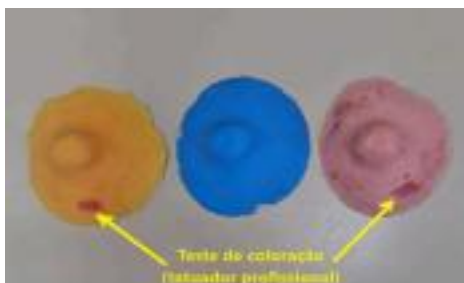


Mold release agent. Source: writers (2023)



First mold with industrial silicone. Source: writers (2023)

Regarding pigmentation, the initial approach involved the application of silicone with a pink coloration, a choice based on the belief that pigmentation, although successful, could blend with the colorations already present in the areolas themselves. This was evidenced when an areola originally made with orange rubber acquired a reddish hue during the micropigmentation process.



COLORATION TEST (PROFESSIONAL TATTOO ARTIST)

**Three initial models, the one on the left prepared with GingiFast Elastic, the middle one with industrial silicone, and the one on the right with GingiFast Rigid.**

Source: writers (2023)



Pigmentation of the molds by a specialized tattoo artist.

Source: writers (2023)

It is worth noting that the coloring is done with micropigmentation materials (the needle being discarded correctly after use), as it would also be compatible with human skin, in addition to being a long-lasting process. Although humans were not involved in the experiments, the search for hypoallergenic products with good recommendations - both in terms of durability, efficiency, and cost-effectiveness - was relentless and recurrent in this project.

Contact was also maintained with oncologist Dr. André Orlando Marques (CRM 85800), who provided various guidelines throughout the project, indicating plastic surgeons, allergists, dermatologists, mastologists, and even professionals in his field, in order to demonstrate the importance of this project.

There was an exchange of emails with the Scientific Review Committee of FEBRACE, which advised against conducting tests on humans, especially in recently operated cases, opening space for the exclusive use of mannequins and 4.0 technology.

For the fixation of the areola(s), after research and testing, it is recommended to use a glue commonly used in the attachment of wigs and hair implants, specifically Bold Hold Active adhesive produced by The Hair Diagram, with 41ml available on the market for R\$83.93 (authorized by ANVISA). Although this project did not involve humans in the experiments, the search for hypoallergenic products with good recommendations was relentless and recurrent in this project.

#### IV. RESULTS

After the production of 10 different molds, satisfactory results were obtained regarding texture and realism. The procedure proved to be economically viable since the use of technology facilitated the modeling process. Cost of R\$ 12.00 per areola with its respective mold already printed. Micropigmentation provided us with a wide variety of shades capable of faithfully "copying"



the coloration of a real areola (R\$ 50.00 each micropigmentation - tattoo artist).



*Micro-pigmented areolas. Source: the authors (2023)*

The material used in the areolas that showed the best results was Gingifast Elastic, soft, with a hardness of 40 Shore, compatible with the various techniques used to make artificial gums and with excellent aesthetic results. It is a silicone-based compound in a two-component cartridge with a cold crosslinker. It has a high elastic modulus to ease removal and reapplication on the breast. It has excellent aesthetic results due to its translucency and vascularization. It is worth noting that this material is approved by ANVISA, as its use occurs in gingival reproduction used by dentists in implantology procedures.

## V. CONCLUSIONS

It is imperative to emphasize that the manifestation of a breast cancer diagnosis or the experience of a traumatic accident are events that transcend human will, and indeed, they are never easy challenges to overcome. Although, over time, it may be said that "the burden becomes more bearable," the profound psychological impact of breast mutilation cannot be underestimated, affecting both women and men. The stigma, melancholy, and distortion of self-image that arise from this loss are true obstacles that do not contribute to the success of the treatments undertaken.

Ensuring, therefore, that individuals affected by such adversities are provided with ample support, not limited to simple surgical interventions for breast reconstruction, but also enabling them to have expedited access to personalized and non-invasive techniques for areola restoration, represents a measure aimed at providing

serenity and building pillars of self-confidence. This will translate into an enhanced ability to successfully face the recovery period and embrace post-treatment life with greater resilience.

It is imperative that all those who face the loss of their breasts, nipples, and areolas receive unconditional support, as experiencing a traumatic event such as an accident or a cancer diagnosis can have profound consequences for psychological well-being. Dealing with the sequelae resulting from these experiences can inflict feelings of self-criticism, trauma, withdrawal, anxiety, and even depression, impacting mental and emotional health significantly.

## REFERENCES

- [1] VARELLA, DRAUZIO. **Breasts**. Available on: <https://drauziovarella.uol.com.br/mulher/mamas/#:~:text=As%20mamas%20s%C3%A3o%20constitu%C3%ADdas%20por,de%20alimento%20para%20os%20beb%C3%AAs.> Accessed on: 05/04/2023
- [2] SOARES, NAYANE PEIXOTO. **Mammary glands**. Available on: <https://www.infoescola.com/anatomia-humana/glandulas-mamarias/>. Accessed on: 05/04/2023
- [3] GRILLO, MARCOS. **Silicone explantation: increases demand for the procedure**. Available on: <https://marcosgrillo.com.br/explante-de-silicone-aumenta-a-procura-pelo-procedimento/> Accessed on: 05/07/2023
- [4] FACINA, GIL. **Breast cancer in men**. Available on: <https://facina.com.br/copia-mamas-densa-s-1> Accessed on: 05/10/2023
- [5] SOLUTUDO - **The city in detail. Rioclarense Network for Cancer Combat - Carmem Prudente**. Available on: <https://www.solutudo.com.br/empresas/sp/rio-claro/ongs-entidades-sociais/rede-rioclarense-de-combate-ao-cancer-carme-m-prudente-3670271> Accessed on: 05/16/2023
- [6] INCA. **Cancer statistics**. Available on: <https://www.gov.br/inca/pt-br/assuntos/ca/ncer/numeros> Accessed on: 05/16/2023
- [7] STATE DEPARTMENT OF HEALTH - Santa Catarina. **Ministry of Health releases R\$ 4 million for breast reconstruction surgeries in Santa Catarina**. Available on: <https://www.saude.sc.gov.br/index.php/noticias-geral/13909-ministerio-da-saude-libera-r-4-milhoes-para-cirurgias-de-reconstrucao-mamaria-em-santa-catarina#:~:text=Toda%20mulher%20que%2C%20em%20virtude,de%20espera%20para%20o%20procedimento.> Accessed on: 05/16/2023
- [8] FAUSTINO, HELEN MACEDO. **University of Southern Santa Catarina - UNESC. Bachelor's degree in Visual Arts**. Accessed on: 05/22/2023.
- [9] FEBRACE. **Forms and safety regulations**. Accessed on: 05/22/2023
- [10] BIERNATH, ANDRÉ. **Hyaluronic acid: the risks and contraindications of the product that became a hit**

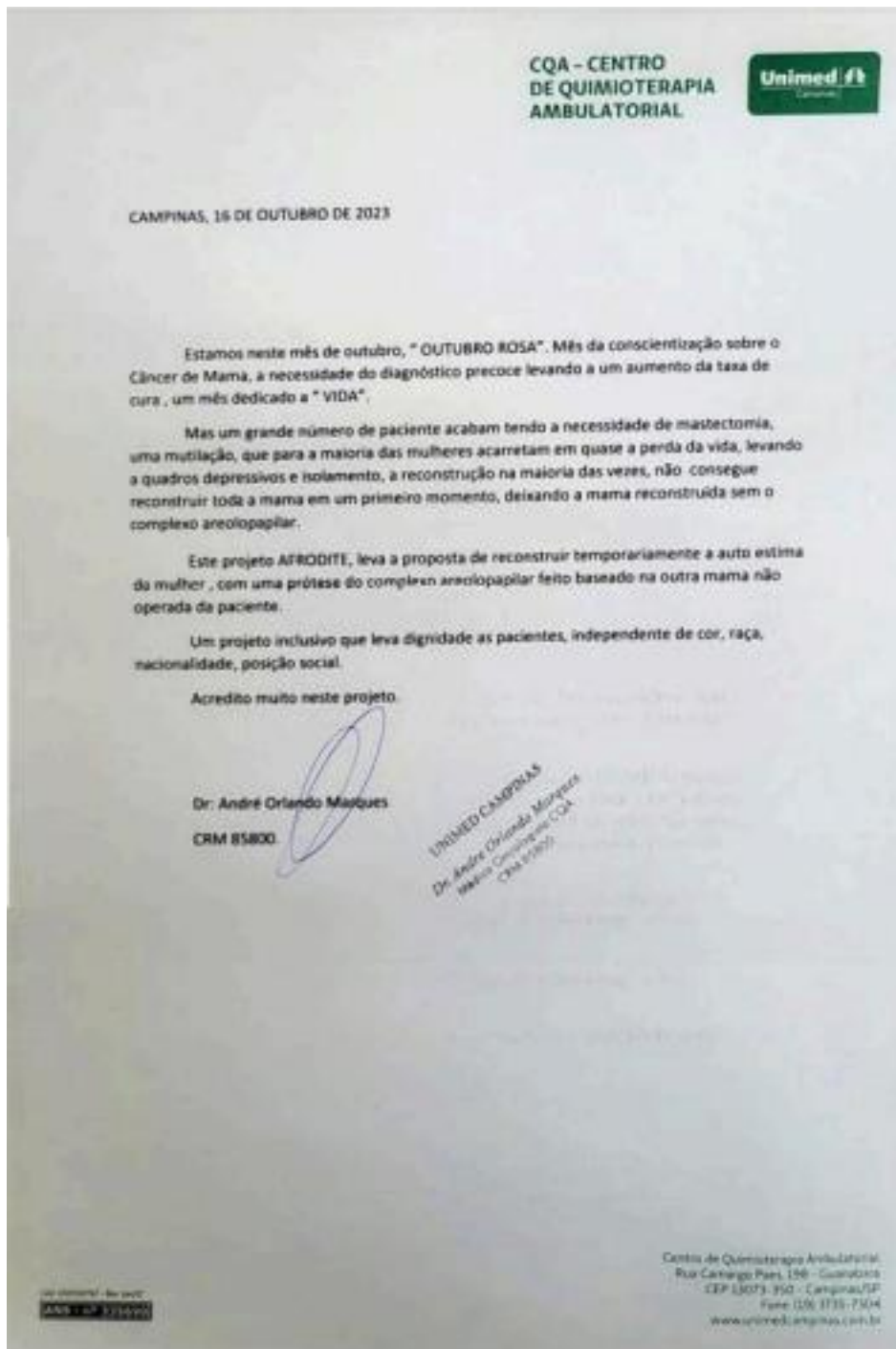
against wrinkles. Available on:  
[https://www.bbc.com/portuguese/geral-62\\_042982](https://www.bbc.com/portuguese/geral-62_042982).  
 Accessed on: 05/27/2023 [10]

[11] LIRA, Valdemir. **Manufacturing processes using 3D printing(Technologies, equipment, study of case and 3D printer project)**. Blucher; 1ª edition (april 30, 2021).  
 Accessed on: 05/29/2023.

[12] E. Lachat \*, T. Landes, P. Grussenmeyer.

**PERFORMANCE INVESTIGATION OF A HANDHELD 3D SCANNER TO DEFINE GOOD PRACTICES FOR SMALL ARTEFACT 3D MODELING.** Ottawa, Canada, 2017. Available on:  
[https://isprs-archives.copernicus.org/articles/XLII-2-W5/427/2017/isprs-archives-XLI\\_I-2-W5-427-2017.pdf](https://isprs-archives.copernicus.org/articles/XLII-2-W5/427/2017/isprs-archives-XLI_I-2-W5-427-2017.pdf).  
 Accessed on: 06/01/2023.

## APPENDICES



(CAMPINAS, OCTOBER 16, 2023: We are in this month of October. "PINK OCTOBER". A month of awareness about breast cancer, the need for early diagnosis leading to an increased cure rate, a month dedicated to "LIFE". But a large

*number of patients end up needing mastectomy, a mutilation, which for most women almost amounts to loss of life, leading to depressive episodes and isolation. Reconstruction, most of the time, cannot fully rebuild the breast in the first instance, leaving the reconstructed breast without the areolopapillary complex. This project, AFRODITE, proposes to temporarily rebuild women's self-esteem with a prosthesis of the areolopapillary complex based on the other non-operated breast of the patient. An inclusive project that brings dignity to patients, regardless of color, race, nationality, or social position. I believe strongly in this project.)*

"Everything is precious to someone who has been deprived of everything for a long time."

**Friedrich Nietzsche**

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